CW generator

aid for radio amateurs

The generator described can accept texts of up to 64 characters long and make this audible in the form of morse signals. This action can be repeated automatically with variable intervals – an aspect that is bound to be of interest to many radio amateurs.

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INTRODUCTION

Transmitting radio amateurs are obliged under International Law to give their call sign at least once every ten minutes. This is to ensure that calling stations can be identified at all times and also to prevent abuse of frequencies allocated to radio amateurs. This requirement is monitored conscientiously by the relevant inspection service, which has the authority to reprimand and, if the offence is repeated, to apply sanctions.

This legal requirement soon gave rise to timers and other automatic warning appliances to alert the operator to transmit the call sign. The generator described in this article is one such automatic device. With the aid of a number of DIP switches, it permits a line of text not exceeding 64 characters to be loaded into its memory, which is then transmitted in morse code at intervals that can be set between 0 s and 15 s or between 0 m and 15 m. The keying speed can also be varied.

The unit is provided with an audio output, a key output, and a push-to-talk output, PTT. It is sufficiently compact to allow its integration into existing equipment.

This short description makes it clear that the unit may be used as a stan-

Table 1.

DIP switch	*Programming mode*	*Run mode*
sw1	*data0*	*rep0*
sw2	*data1*	*rep1*
sw3	*data2*	*rep2*
sw4	*data3*	*rep3*
sw5	*data4*	*sec/min*
sw6	*char/digit*	*wpm0*
sw7	*store*	*wpm1*
sw8	*run/prog*	*run/prog*

(sw1 = S1(1); sw2 = S1(2); … sw8 = S1(8))

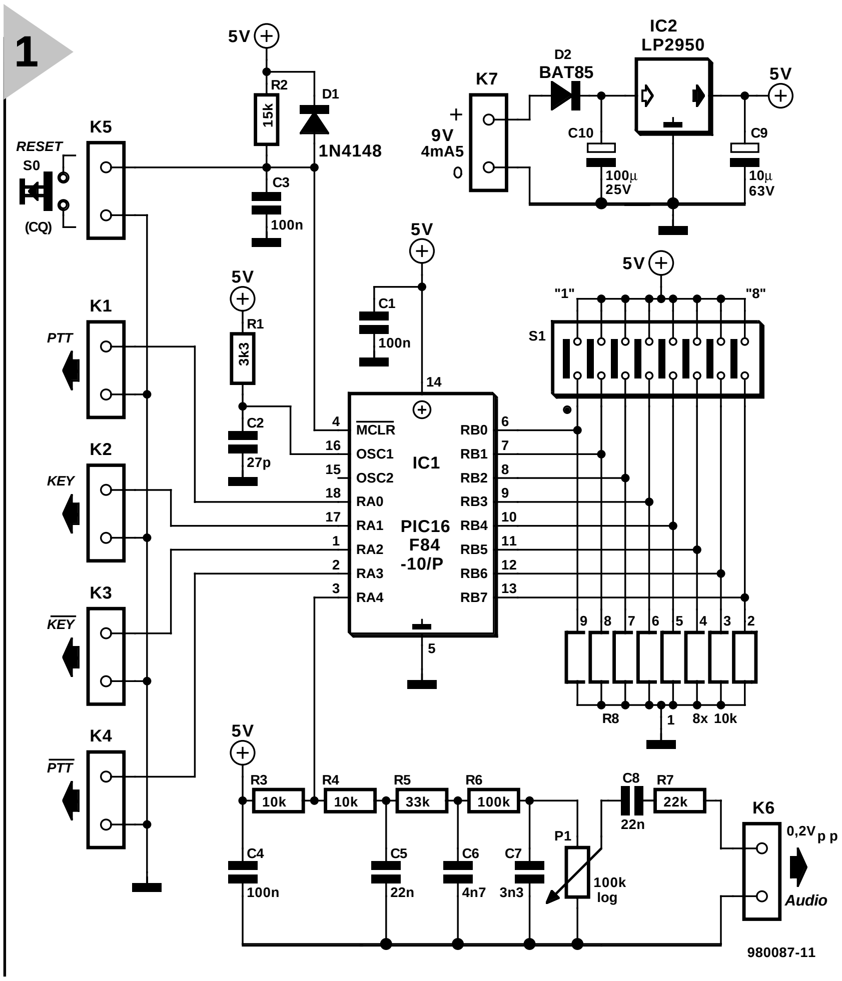

Figure 1. The circuit of the CW generator is based on a programmed PIC processor.

dard call generator, a CQ generator, a beacon, or as a morse test generator. With a bit of a push, it may also be used to learn the morse code.

FUNCTIONAL DESCRIPTION

The circuit in the diagram in **Figure 1** shows that the design is straightforward. It consists of a programmed PIC processor, IC_1, octal DIP switch, S_1, output filter R_4–R_6-C_5–C_7, and a power supply regulator, IC_2.

The unit is linked to the outside world via five terminals, K_1–K_5, made from PCB pins. A sixth, K_6 also made from PCB pins, delivers the audible morse signal at a frequency of 1000 Hz.

Key terminals K_2 output the morse characters in the shape of high logic levels when push-to-talk terminals K_1 are high during transmissions.

The inverse signals of those at K_2 and K_1 are also available: at K_3 and K_4 respectively.

If desired, a simple push-button switch may be linked to terminals K_5 to serve as a reset switch. This is not really necessary, since the generator may be reset by switching the supply voltage off and on again.

The actual operation of the unit is performed almost wholly by processor IC_1. This is loaded with a simple program whose execution is carried out according to the setting of the DIP switches. The function of these switches is shown in **Table** 1. In the table, 'rep' means repetition interval and 'wpm' means words per minute.

Programming mode

Switch $S_{1(8)}$ enables selecting the *programming mode* or the *run mode*. This selection must always be made before the generator is switched on, or before a reset as the case may be.

In the programming mode, $S_{1(1–5)}$ are used to input data. The setting of $S_{1(6)}$ determines whether these data are letters or numerals. When this switch is on, switches $S_{1(1–5)}$ input the alphabet plus space and slash. When $S_{1(6)}$ is off, switches $S_{1(1–5)}$ input numerals 0–9. This is shown in **Table** 3 and will be reverted to shortly.

Switch $S_{1(7)}$ serves to store the relevant characters into an EEPROM. This is done by setting it from on to off or vice versa.

Run mode

When $S_{1(8)}$ is on, the run mode of the other switches is selected. Switches $S_{1(1–4)}$ enable the repetition interval of the input text to be set. Switch $S_{1(5)}$ determines whether this time is in seconds (switch on) or in minutes (switch off). The interval may be set between 0 s and 15 s or between 0 m and 15 m.

Switch $S_{1(5)}$ also has another functions. When switches $S_{1(1–4)}$ are all off, and $S_{1(5)}$ is also off, the input text is transmitted once after the supply is switched on or after a reset. When $S_{1(5)}$ is on, the input text is transmitted continuously. **Table 2** shows the process for the various settings of

2

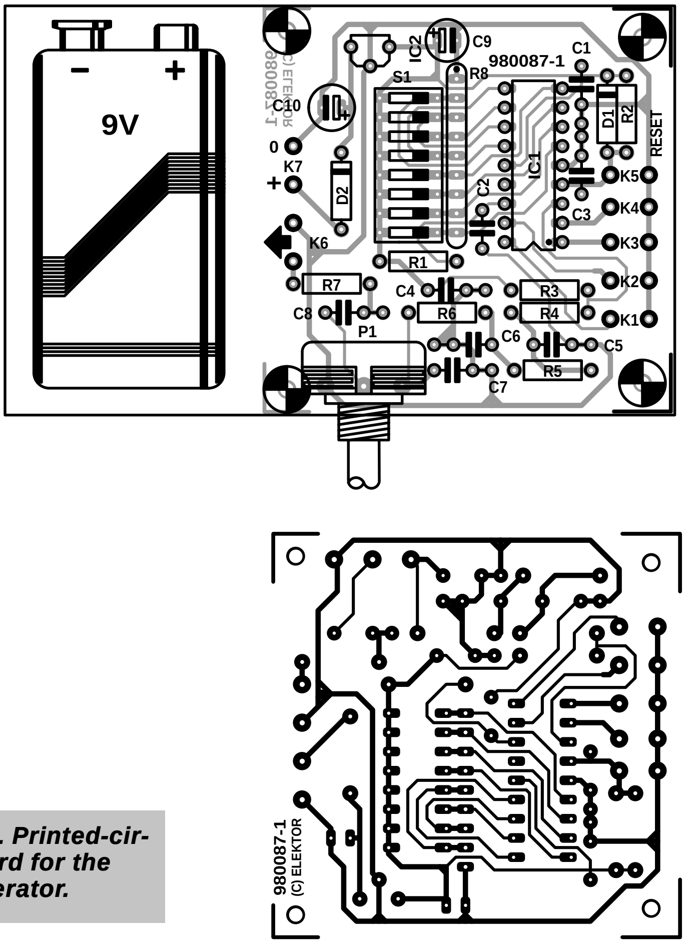

Figure 2. Printed-circuit board for the CW generator.

Parts list

Resistors:
R_1 = 3.3 kΩ
R_2 = 15 kΩ
R_3, R_4 = 10 kΩ
R_5 = 33 kΩ
R_6 = 100 kΩ
R_7 = 22 kΩ
R_8 = resistor array, 8×10 kΩ

Capacitors:
C_1, C_3, C_4 = 0.1 µF
C_2 = 27 pF
C_5, C_8 = 0.022 µF
C_6 = 0.0047 µF
C_7 = 0.0033 µF
C_9 = 10 µF, 63 V, radial
C_{10} = 100 µF, 25 V, radial

Semiconductors:
D_1 = 1N4148
D_2 = BAT85

Integrated circuits:
IC_1 = PIC16F84 *
IC_2 = LP2950CZ5.0 (National Semiconductor
* Available programmed under Order No. 986512 – see Readers' Services toward the end of this issue.

Miscellaneous:
K_1–K_7 = PCB pins
S_0 = push-button switch
S_1 = octal DIP switch
Enclosure as and if required
PCB Order No. 980087 – see Readers' Services toward the end of this issue.

switches $S_{1(1–5)}$.

The keying speed is set with switches $S_{1(6)}$ and $S_{1(7)}$. When both these switches are off, the speed is 10 w.p.m.; when $S_{1(6)}$ is on and $S_{1(7)}$ is off, the speed is 15 w.p.m., when $S_{1(6)}$ is off and $S_{1(7)}$ is on, the speed is 20 w.p.m. and when both switches are on, the speed is 25 w.p.m.

PROGRAMMING

The wanted text is input by first setting switch $S_{1(8)}$ to off before the supply is switched on or the circuit is reset. Each subsequent programming step consists of setting $S_{1(6)}$ as relevant and switches $S_{1(1–5)}$ according to Table 3. After each character has been input, switch $S_{1(7)}$ from off to on or vice versa to store the character in memory. When the entire text has been input in this manner, set switch $S_{1(8)}$ to on, followed by setting $S_{1(7)}$ from off to on or vice versa as the case may. Note that in Table 3 the character 0 indicates a space which has a standard duration of seven dots.

EXAMPLE

Assume that radio amateur PA0XYZ wants to use the unit as an automatic call generator. He/she sets $S_{1(8)}$ to off, switches the supply on, or presses the reset button. This is followed by the following programming steps:

sw1	*sw2*	*sw3*	*sw4*	*sw5*	*sw6*	*sw7*
off	*off*	*off*	*off*	*on*	*on*	→
on	*off*	*off*	*off*	*off*	*on*	←
off	*off*	*off*	*off*	*off*	*off*	→
off	*off*	*off*	*on*	*on*	*on*	←
on	*off*	*off*	*on*	*on*	*on*	→
off	*on*	*off*	*on*	*on*	*on*	←
NOTE. ←→ = change from "on" to "off" or vice versa						
(sw1 = S1(1); sw2 = S1(2); … sw7 = S1(7)						

The programming is terminated by setting $S_{1(8)}$ to on and switching $S_{1(7)}$ from on to off or vice versa as the case may be.

Since the call is to be repeated every 10 minutes, the operator must set the timer for this interval. Also, a keying speed of 25 w.p.m. is desired. The whole process is programmed by setting the various switches as follows:

sw1	*sw2*	*sw3*	*sw4*	*sw5*	*sw6*	*sw7*
off	*on*	*off*	*on*	*off*	*on*	*on*
10				*min.*	*25 wpm*	
(sw1 = S1(1); sw2 = S1(2); … sw7 = S1(7)						

After this has been done, the generator must be reset or the supply voltage switched on. Any changes in the settings of the switches during the run mode become effective only after a reset.

CONSTRUCTION

The generator is best built on the printed-circuit board shown in **Fig-**

Table 2.

sw1	sw2	sw3	sw4	sw5	Interval
0	0	0	0	0	Send once
1	0	0	0	0	1 minute(s)
0	1	0	0	0	2
1	1	0	0	0	3
0	0	1	0	0	4
1	0	1	0	0	5
0	1	1	0	0	6
1	1	1	0	0	7
0	0	0	1	0	8
1	0	0	1	0	9
0	1	0	1	0	10
1	1	0	1	0	11
0	0	1	1	0	12
1	0	1	1	0	13
0	1	1	1	0	14
1	1	1	1	0	15
0	0	0	0	1	Send continuously
1	0	0	0	1	1 seconde(s)
0	1	0	0	1	2
1	1	0	0	1	3
0	0	1	0	1	4
1	0	1	0	1	5
0	1	1	0	1	6
1	1	1	0	1	7
0	0	0	1	1	8
1	0	0	1	1	9
0	1	0	1	1	10
1	1	0	1	1	11
0	0	1	1	1	12
1	0	1	1	1	13
0	1	1	1	1	14
1	1	1	1	1	15

(sw1 = S1(1); sw2 = S1(2); … sw5 = S1(5)

Table 3. Programming table

sw1	sw2	sw3	sw4	sw5	character (sw6=1)	numeral (sw6=0)	decimal
0	0	0	0	0	“ “	“0”	0
1	0	0	0	0	“A”	“1”	1
0	1	0	0	0	“B”	“2”	2
1	1	0	0	0	“C”	“3”	3
0	0	1	0	0	“D”	“4”	4
1	0	1	0	0	“E”	“5”	5
0	1	1	0	0	“F”	“6”	6
1	1	1	0	0	“G”	“7”	7
0	0	0	1	0	“H”	“8”	8
1	0	0	1	0	“I”	“9”	9
0	1	0	1	0	“J”		10
1	1	0	1	0	“K”		11
0	0	1	1	0	“L”		12
1	0	1	1	0	“M”		13
0	1	1	1	0	“N”		14
1	1	1	1	0	“O”		15
0	0	0	0	1	“P”		16
1	0	0	0	1	“Q”		17
0	1	0	0	1	“R”		18
1	1	0	0	1	“S”		19
0	0	1	0	1	“T”		20
1	0	1	0	1	“U”		21
0	1	1	0	1	“V”		22
1	1	1	0	1	“W”		23
0	0	0	1	1	“X”		24
1	0	0	1	1	“Y”		25
0	1	0	1	1	“Z”		26
1	1	0	1	1	“/”		27

(sw1 = S1(1); sw2 = S1(2); … sw5 = S1(5))

ure 2. If this is obtained, together with the programmed processor, via the Readers’ Services (see toward the end of this issue), the construction of the generator with reference to the circuit diagram and the parts list becomes very easy: most constructors should be able to finish it in well under an hour.

The board is small so that is can easily be integrated into an existing transmitter or transceiver. Alternatively, it may be built into a small discrete case to become a stand-alone unit—see photograph.

Since the generator draws a current of not greater than 4.5 mA, it may be powered by a 9 V (PP3) battery connected to K_7. There is space for this battery on the board. Voltage regulator IC_2 ensures a stable 5 V supply line.

There are no calibrations needed; the only potentiometer, P_1, varies the loudness of the 1000 Hz output tone.

The repetition intervals and keying speeds mentioned in the text are based on a clock frequency of 4 MHz This frequency is determined approximately by R_1 and C_1. If it is to be 4 MHz accurately, replace R_1 by a 5 kΩ preset potentiometer to enable the frequency to be set.

USAGE

When the unit is to be used as a CQ transmitter, the key output may be used to drive a relay that bridges the morse key. Using the earlier example, the text “CQCQDEPA0XYZ” may then programmed. The DIP switches are to be set so that after each and every reset this text is transmitted once. In this way a call may be made simply by pressing the reset button.

The unit may also be used for direction finding exercises. In this case, the push-to-talk terminals should be used to energize a relay via a transistor to switch on the transmitter. The audio output is linked to the input of a microphone preamplifier. The text may consist of numerals 0 and 5 for programming long and short signals. A real text may, of course, also be used. A good repetition interval would be one minute.

When the unit is used as automatic call generator, the audio output signal should be mixed with the speech modulation. This should be done so that the morse signals are clearly audible without drowning out the speech. Setting the loudness with P_1 is facilitated by temporarily setting the timing to 0, resulting in the continuous transmitting of the signal. The correct position of P_1 is readily arrived at with the use of a suitable receiver or the help of a fellow amateur.

To obtain a peak output voltage of 50 mV, it may be necessary to alter the value of resistor R_7 to about ×10 the load across terminals K_6.

Finally, if the unit is used solely as call generator, the key and push-to-talk terminals are not needed and may be left open.

[980087]